

BUREAU OF WATER

South Carolina Department of Health and Environmental Control

SHELLFISH MANAGEMENT AREA 4

2004 ANNUAL UPDATE

Shellfish Sanitation Program

Water Monitoring, Assessment and Protection Division
Environmental Quality Control - Bureau of Water
2600 Bull Street
Columbia, South Carolina 29201

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2004 ANNUAL UPDATE

[Data Through December 2003]

Shellfish Management Area 4 Shellfish Sanitation Program



Preparer: Fred K. Earnhardt, District Shellfish Program Manager
Waccamaw Environmental Quality Control District
1705 Oak Street Plaza
Myrtle Beach, South Carolina 29577

Reviewers/Editors:
David G. Baize, Division Director
(and) Charles Newell, Shellfish Program Manager
Water Monitoring, Assessment, and Protection Division
Environmental Quality Control - Bureau of Water
2600 Bull Street
Columbia, South Carolina 29201

David G. Baize, Division Director
Water Monitoring, Assessment, and Protection Division
Environmental Quality Control - Bureau of Water

TABLE OF CONTENTS

Shellfish Management Area 04 Annual Update

Summary	2
Introduction	2
Pollution Source Survey.....	7
Survey Procedures	7
Point Source Pollution	7
A. Municipal and Community Waste Treatment Facilities.....	7
B. Industrial Waste.....	7
C. Marinas	7
D. Radionuclides	8
Nonpoint Source Pollution.....	8
A. Urban and Suburban Stormwater Runoff.....	8
B. Agricultural Runoff.....	8
C. Individual Sewage Treatment and Disposal Systems	9
D. Wildlife and Domestic Animals	9
E. Boat Traffic.....	10
F. Hydrographic and Habitat Modification	10
G. Marine Biotoxins	10
Hydrographic and Meteorological Characteristics.....	10
Water Quality Studies	12
Conclusions and Recommendations	13
References	16
Murrells Inlet Conditionally Approved Areas.....	26
<i>Management Plan; Evaluation of Management Plan</i>	

Figures and Tables

Figures:

(1) Shellfish Harvesting Classification Prior to this Survey	19
(2) Current Shellfish Harvesting Classification	20
(3) Potential Pollution Sources	21

Tables:

(1) Murrells Inlet Pollution Event Closures.....	17
(2) Shellfish Water Quality Sampling Stations Description	18
(3) FECAL COLIFORM Bacteriological Data Summary Sheets A-B	
A - All Station, (2001-2003).....	22
B - Selected Stations, Open Status (2001-2003)	23
(4) Water Quality Sampling Station Data	24
(5) Rainfall Data: Brookgreen Garden, SC (January 2001 - December 2003).....	25

ANNUAL UPDATE
Shellfish Management Area 04
SCDHEC EQC Bureau of Water

Data Inclusive Dates:

01/01/01 thru 12/31/03

Classification Change:

 Yes X No

Shoreline Survey Completed: Yes

(I)ncreased/(D)ecreased/(N)one:

 N Approved

 N Conditionally Approved

 N Restricted

 N Prohibited

Prior Report & Date: Annual-2003

SUMMARY

Runoff from rainfall events continues to strongly influence Area 04 shellfish water quality. Calendar year 2002 and 2003 rainfall levels were slightly above those recorded for calendar year 2001. While Murrells Inlet exhibited a slight reduction in water quality for the current three-year review period, the slight increase in 2003 rainfall was not significant enough to result in a change in the area's current classification.

All but two shellfish monitoring stations within the Pawleys Island/Litchfield estuary exceeded both the geometric mean and the estimated 90th percentile shellfish indicator standards criteria for this reporting period. All portions of the Pawleys Island/Litchfield estuary will remain Restricted. Portions of the this estuary may be suitable for conditional management but this will require continued special study in order to determine feasibility.

No changes in the Area 04 classification will be implemented for the 2004-2005 shellfish season.

INTRODUCTION

PURPOSE AND SCOPE

The authority to regulate the harvest, sanitation, processing and handling of shellfish is granted to the South Carolina Department of Health and Environmental Control by Section 44-1-140 of the Code of Laws of South Carolina, 1976, as amended. The Department promulgated Regulation 61-47, which provides the rules used to implement this authority and outlines the requirements applied in regulating shellfish sanitation in the State. This regulation specifically addresses classification of shellfish harvesting areas and requires that all areas be examined by sanitary and bacteriological surveys and classified into an appropriate shellfish harvesting classification.

The National Shellfish Sanitation Program (NSSP) Guide For The Control Of Molluscan Shellfish is used by the United States Food and Drug Administration (USFDA) to evaluate state shellfish sanitation programs. The NSSP Model Ordinance requires that a sanitary survey be in place for each growing area

prior to its use as a source of shellfish for human consumption and prior to the area's classification as Approved, Conditionally Approved, Restricted, or Conditionally Restricted. Each sanitary survey shall be updated on an annual basis and accurately reflect changes which have occurred within the area. Requirement of the annual reevaluation include, at a minimum, field observations of pollution sources, an analysis of water quality data consisting of the past year's data in combination with appropriate previously collected data, review of reports and effluent samples from pollution sources, and review of performance standards for discharges impacting the growing area. A brief report documenting the findings shall also be provided.

The following criteria consistent with the NSSP Model Ordinance and S. C. Regulation 61-47 are used in establishing shellfish harvesting classifications:

Approved - Growing areas shall be classified Approved when the sanitary survey concludes that fecal material, pathogenic microorganisms, and poisonous or deleterious substances are not present in concentrations which would render shellfish unsafe for human consumption. The Approved area classification shall be designated based upon a sanitary survey, which includes water samples collected from stations in the designated area adjacent to actual or potential sources of pollution. For waters sampled under adverse pollution conditions, the median fecal coliform Most Probable Number (MPN) or the geometric mean MPN shall not exceed fourteen per one hundred milliliters, and not more than ten percent of the samples shall exceed a fecal coliform MPN of forty-three per one hundred milliliters (per five tube decimal dilution). For waters sampled under a systematic random sampling plan, the geometric mean fecal coliform MPN shall not exceed fourteen per one hundred milliliters, and the estimated ninetieth percentile shall not exceed an MPN of forty three (per five tube decimal dilution). Computation of the estimated ninetieth percentile shall be obtained using NSSP Guidelines.

Conditionally Approved - Growing areas may be classified Conditionally Approved when they are subject to temporary conditions of actual or potential pollution. When such events are predictable, as in the malfunction of wastewater treatment facilities, non-point source pollution from rainfall runoff, discharge of a major river, or potential discharges from dock or harbor facilities that may affect water quality, a management plan describing conditions under which harvesting will be allowed shall be adopted by the Department, prior to classifying an area as Conditionally Approved. Where appropriate, the management plan for each Conditionally Approved area shall include performance standards for sources of controllable pollution, e.g., wastewater treatment and collection systems, evaluation of each source of pollution, and means of rapidly closing and subsequent reopening areas to shellfish harvesting. Memorandums of agreements shall be a part of these management plans where appropriate.

Restricted - Growing areas shall be classified Restricted when sanitary survey data show a limited degree of pollution or the presence of deleterious or poisonous substances to a degree which may cause the water quality to fluctuate unpredictably or at such a frequency that a Conditionally Approved classification is not feasible. Shellfish may be harvested from areas classified as Restricted only for the purposes of relaying or depuration and only by special permit issued by the Department and under Department supervision. For Restricted areas to be utilized as a source of shellstock for depuration, or as source water for depuration, the fecal coliform geometric mean MPN of restricted waters sampled under adverse pollution conditions shall not exceed eighty-eight per one hundred milliliters and not more than ten percent of the samples shall exceed a MPN of two hundred and sixty per one hundred milliliters for a five tube decimal dilution test. For waters sampled under a systematic random sampling plan, the fecal coliform

geometric mean MPN shall not exceed eighty-eight per one hundred milliliters and the estimated ninetieth percentile shall not exceed an MPN of two hundred and sixty (per five tube decimal dilution). Computation of the estimated ninetieth percentile shall be obtained using NSSP guidelines.

Conditionally Restricted - Growing areas may be classified Conditionally Restricted when they are subject to temporary conditions of actual or potential pollution. When such events are predictable, as in the malfunction of wastewater treatment facilities, non-point source pollution from rainfall runoff, discharge of a major river, or potential discharges from dock or harbor facilities that may affect water quality, a management plan describing conditions under which harvesting will be allowed shall be prepared by the Department prior to classifying an area as Conditionally Restricted. Where appropriate, the management plan for each Conditionally Restricted area shall include performance standards for sources of controllable pollution (e.g., wastewater treatment and collection systems and an evaluation of each source of pollution) and description of the means of rapidly closing and subsequent reopening areas to shellfish harvesting. Memorandums of agreements shall be a part of these management plans where appropriate. Shellfish may be harvested from areas classified as Conditionally Restricted only for the purposes of relaying or depuration and only by permit issued by the Department and under Department supervision. For Conditionally Restricted areas to be utilized as a source of shellstock for depuration, the fecal coliform geometric mean MPN of Conditionally Restricted waters sampled under adverse pollution conditions shall not exceed eighty-eight per one hundred milliliters and not more than ten percent of the samples shall exceed a MPN of two hundred and sixty per one hundred milliliters for a five tube decimal dilution test. For waters sampled under a systematic random sampling plan, the fecal coliform geometric mean MPN shall not exceed eighty-eight per one hundred milliliters and the estimated ninetieth percentile shall not exceed an MPN of two hundred and sixty (per five tube decimal dilution). Computation of the estimated ninetieth percentile shall be obtained using NSSP guidelines.

Prohibited - Growing areas are classified Prohibited if there is no current sanitary survey or if the sanitary survey or monitoring data show unsafe levels of fecal material, pathogenic microorganisms, or poisonous or deleterious substances in the growing area or indicate that such substances could potentially reach quantities which could render shellfish unfit or unsafe for human consumption.

BACKGROUND INFORMATION

Area 04 consists of 4364 acres of habitat suitable for production of shellfish. The area is comprised of two separate estuaries; Murrells Inlet, and Pawleys Island/Litchfield, which includes Midway Inlet and Pawleys Inlet. A portion of U.S. Highway 17 that extends through the Waccamaw Neck defines the area's western boundary; the northern boundary extends through Horry County uplands approximately one mile north of Garden City Beach. The eastern boundary is the Atlantic Ocean, and the southern boundary extends from the Atlantic Ocean to U. S. Highway 17, approximately one mile south of Pawleys Inlet in Georgetown County.

Murrells Inlet is located in the northern portion of Area 04 and has long been considered to be the most economically important shellfish producing area along South Carolina's northern coast (Caulder et al., 1976). Murrells Inlet encompasses approximately 3,108 acres of habitat suitable for the production of shellfish. This includes numerous commercial shellfish Culture Permit Areas, two State Shellfish Grounds that are used both commercially and recreationally, and two Recreational Shellfish Grounds. The northern boundary of the Murrells Inlet estuary is Garden City, a densely developed, unincorporated portion of

Horry County, and its southern border is defined by Huntington Beach State Park. The Atlantic Ocean is to the east, and lands of the Waccamaw Neck define the western boundary.

Prior to this survey in Murrells Inlet, approximately 1814 acres were classified Approved, 403 acres were classified Conditionally Approved, 736 acres were classified Restricted, and 155 acres were classified Prohibited. Current management criteria for the Conditionally Approved portion of Murrells Inlet dictate closure upon receipt of 1.0 inches of rainfall within a 24-hour period.

The Pawleys Island/Litchfield estuary comprises approximately 1,256 acres of Restricted shellfish habitat. Two State Shellfish Grounds within the Litchfield portion of the estuary are occasionally utilized for relay purposes. Pawleys Island has not been utilized as a source of shellfish for relay projects.

The harvesting classifications of Area 04 prior to this sanitary survey were as follows:

Prohibited:

Murrells Inlet

1. Those waters within approximately 1000 feet of Captain Dick's/Voyager View Marinas;
2. Those waters within approximately 1000 feet of the docking facilities of Bovines, Snug Harbor, H & C Fishers, and Anchor Inn;
3. Those waters within approximately 1000 feet of Marina Colony;
4. Those waters within approximately 1000 feet of the Marlin Quay Marina.

Pawleys Island/Litchfield

None.

Restricted:

Murrells Inlet

1. Portions of the Garden City Canal north of the Marlin Quay Marina closure zone
2. All portions of Main Creek north of Flagg Creek, including the adjacent flats extending eastward from Station 25 to the Garden City Canal;
3. All waters of Parsonage Creek extraneous of marina closure zones,
4. All small feeder creeks and marsh adjacent to the mainland extending from the northern end of Allston Creek to a point 200 meters south of Hughes Landing;
5. Those waters within 1000 feet of the Huntington Beach State Park pond outfall.
6. Alston Creek, from Station 07 to Parsonage Creek.
7. Main Creek, from Station 02 to Station 27.

Pawleys Island/Litchfield

All waters.

Conditionally Approved:

Murrells Inlet

1. All portions of Flagg Creek and adjacent flats not included in the Marina Colony closure zone:

2. The Garden City Canal, between station 04A and the Marlin Quay Marina closure zone;
3. Oaks Creek and adjacent flats, from Station 18 to within 1000 feet of the Huntington Beach State Park pond outfall, including Public Shellfish Ground R351;
4. All portions of the central part of the Murrells Inlet estuary, west of a line extending from the Voyagers View marina closure zone to the extreme eastern portion of Allston Creek, excluding all portions of Parsonage and Allston Creeks.
5. All waters of Oyster Cove.

Pawleys Island/Litchfield

None.

Approved:

Murrells Inlet

1. Those portions of Main Creek extending from Station 25 to Station 05, excluding Marina closure zones;
2. Culture Permit area 356.
3. Portions of Allston Creek, from Station 07 to Oaks Creek.
4. Those portions of Oaks Creek and areas adjacent to Drunken Jack Island from Station 05 to Station 18.
5. Southern portions of the estuary from Station 07 to Station 18, including State Shellfish Ground S354 and portions of Public Shellfish Ground R355.
6. All portions of the central part of the estuary east of a line extending from the Voyagers View marina closure zone near Station 17 to Station 24, excluding any portions of Allston Creek, any portion of Captain Dick's - Voyagers View Marina closure zone, and any portion of Oyster Cove;
7. C370 and portions of C371, excluding marina closure zones and portions of C371 north of Flagg Creek and east of Main Creek.

Pawleys Island/Litchfield

None.

POLLUTION SOURCE SURVEY

SURVEY PROCEDURES

Shoreline survey activities are conducted in Area 04 on a continual basis by the Waccamaw District Shellfish Sanitation staff. Extensive visual examination of lands adjacent to the waters of Area 04 was conducted to determine type of activities, location of significant concentrations of domestic animals and other actual and potential sources of pollution entering shellfish growing waters.

A review of SCDHEC Waccamaw District files was conducted for information on central collection and disposal systems and lift stations. Surveys indicated the majority of the Murrells Inlet and Litchfield Beach areas were serviced by central wastewater collection systems. Wastewater disposal on

the mainland adjacent to Pawleys Island was accomplished almost exclusively through the use of individual sewage treatment and disposal systems. In June of 2004, notification was received from Georgetown County Water and Sewer District that they plan to construct sewer facilities on the mainland side of Pawleys Island.

Additionally, a shoreline survey reconnaissance was conducted of sites with a high probability of structures being serviced by individual sewage treatment and disposal systems.

POINT SOURCE POLLUTION

- A. Municipal and Community Waste Treatment Facilities** - Two wastewater treatment facilities provide service to lands adjacent to shellfish growing waters; however, none discharge within the area. Georgetown County Water and Sewer Authority provides wastewater disposal service to Litchfield Beach, Pawleys Island and portions of Murrells Inlet. Treated wastewater is discharged to the Waccamaw River and does not affect Area 04 shellfish waters. Portions of the Pawleys Island Community, located on the mainland, are serviced by Georgetown County Water and Sewer District. Grand Strand Water and Sewer provides service to the Horry County portions of Murrells Inlet and Garden City.

Both authorities have acknowledged their responsibility to promptly notify the Department in the event of spillage of untreated wastewater that could affect Area 04 shellfish growing waters. Lift stations with the potential of adversely affecting shellfish growing waters are provided with emergency power, visual and audible alarms, and telemetry systems to alert repair crews and nearby residents when malfunctions occur. These lift stations have been inspected by SCDHEC and found to be well maintained by the local sewer authority.

- B. Industrial Waste** - Industrial wastewater discharges have not been permitted within Area 04.
- C. Marinas** - Several marinas and multiple docking facilities are located within the Murrells Inlet estuary. Locations of these facilities are shown in Figure 3. Marinas are not located within the Pawleys Island/Litchfield system due to the estuary's shallow waters. Water depths limit the size of watercraft using the area to typically less than 16 feet in length. Murrells Inlet marinas are encompassed by approximately 1000' Prohibited closure zones.
- D. Radionuclides** - Sources of radionuclides have not been identified within Area 04, and radionuclide monitoring has not been conducted. No other sources of poisonous or deleterious substances have been identified within the area.

NONPOINT SOURCE POLLUTION

- A. Urban and Suburban Stormwater Runoff** - Stormwater runoff is a substantial problem in the majority of Area 04 waters due to dense development of the surrounding area. The lands adjacent to shellfish growing waters in Area 04 consist of various soil types and conditions that have been defined by the United States Department of Agriculture, Soil Conservation Service (1982) utilizing general classifications and descriptions.

A demarcation in soil type and condition occurs between the Murrells Inlet and Pawleys Island/Litchfield system. Lands adjacent to Murrells Inlet and extending westward toward the Waccamaw River range from level to gently sloping and possess soils that are moderately to excessively drained. Soil types are generally Lakeland-Chipley-Centenary fine sands. Areas to the south of the demarcation line are primarily level and possess poorly to moderately well drained soils. Soil types are generally Leon-Lynn Haven sands in addition to Chipley fine sands.

There are a few large, undisturbed tracts of forested lands adjacent to Area 04 shellfish growing waters. However, several former rice plantations, located west of U. S. Highway 17, as well as a single tract east of this highway are currently under various stages of development. This construction has generally been limited to single and multi-family housing and golf courses. An increase in human population density has resulted in the development of shopping centers, restaurants, and gasoline stations primarily adjacent to U. S. Highway 17. When construction requires a Department permit or U. S. Army Corps of Engineers certification, an approved Office of Coastal Resource Management site-specific stormwater management permit must be obtained.

In the early 1980's, the Department attempted to disinfect the initial flush of bacterial pollutants entering the Murrells Inlet estuary following rainfall events. This effort involved using both chlorine and ozone contact chambers in drainage ditches. Neither treatment system appeared to lower bacteria levels effectively in adjacent shellfish growing areas and, as a result, treatment was discontinued.

- B. Agricultural Runoff** - Area 04 does not have great potential for agricultural nonpoint source pollution. Commercial crop production throughout the area is limited due to soil characteristics as well as land use economics. Small agricultural operations exist at some upland sites. Brookgreen Gardens is a 9127-acre nature park located approximately one-half mile southwest of Murrells Inlet. Brookgreen Gardens has gravitated from its former policy of benign forestry management. The present methodology provides for timber harvest through clear cutting.

Shellfish tissue sampling for pesticides, herbicides and heavy metals was not conducted in Area 04 during the survey period.

- C. Individual Sewage Treatment and Disposal (ISTD) Systems** - Generally, individual sewage treatment and disposal systems in Area 04 are being replaced by municipal wastewater collection and treatment facilities. Central treatment systems have less potential to impact shellfish growing waters than ISTD systems, although central treatment system malfunctions can occasionally result in spills of untreated wastewater to the environment.

Grand Strand Water and Sewer Authority personnel reported two small areas bordering Main Creek in the northern portion of Murrells Inlet that are not currently served by central sewer. Additionally, a six-house development utilizing ISTDs borders uplands west of Station 25.

Personnel with the Department's Division of Environmental Sanitation conducted a survey, beginning in southern Horry County and progressing through portions of Georgetown county, of Murrells Inlet sites with a high probability of having operational septic systems. Initial screenings cross-referencing county tax maps with active water and sewer authority customer accounts. Sites

not shown on authority maps as being provided with central sewer were visited for evaluation. Sites determined to have active septic systems were mapped with a Trimble GeoExplorer GPS unit. Of a total of 4014 sites, 1869 were visited. Of the 1869, 119 proved to have active septic systems. Of these, 101 were in Horry County and the remaining 18 were in Georgetown County. Of the total number identified, 76 were concentrated within two mobile home parks in close proximity to the northwestern portions of the estuary. The survey identified only two systems that were described as 'malfunctioning'. The report indicates that they were repaired before official notice could be issued to the property owners.

The Division of Environmental Sanitation, assisted by members of the Waccamaw District Shellfish Program staff, conducted a survey along the Pawley's Island mainland during the winter of 2001. Overt malfunctions were documented in the Maryville community in the southern portion of the survey area. This area is separated from the marsh by a golf course- a distance of approximately one mile between the community and the estuary.

- D. Wildlife and Domestic Animals** - Area 04 supports substantial populations of both wildlife and domestic animals. Brookgreen Gardens, the nature park situated approximately one-half mile southwest of Murrells Inlet, contains a variety of wild animals confined for exhibition. Huntington Beach State Park, located along the southern reaches of the estuary, is a popular bird watching area and public beach. Brookgreen Gardens and Huntington Beach support natural populations of rabbit, white-tailed deer, raccoon, opossum, alligators, rodents, songbirds, shorebirds, and migratory waterfowl typical of the coastal Carolinas. Murrells Inlet receives runoff from both of these areas. Other portions of Area 04 support similar natural wildlife populations.

Domestic animal populations in the area are generally limited to dogs and cats. However, there are several horse stables within approximately two miles of estuarine waters. A small herd of goats is located along Murrells Inlet Road in central Murrells Inlet, approximately one-half mile west of Parsonage Creek canal.

- E. Boat Traffic** - Murrells Inlet is a small estuary; however, it provides ocean access for many recreational and commercial vessels. Boat traffic is heaviest during summer months and on weekends during the spring and fall. Weekday boating activity during the spring and fall is moderate. Boat traffic during the winter months is dependent on weather conditions and fisheries product prices and may range from very light to moderate. Boat traffic in the shallow Pawleys Island/Litchfield system is generally light, consisting primarily of boats less than 16 feet in length.
- F. Hydrologic and Habitat Modification** - Hydrologic and habitat modification in estuarine areas requires both State and federal approval. A rubble jetty system was constructed at the mouth of Murrells Inlet. Maintenance dredging has been allowed in several Murrells Inlet locations (primarily marinas) and in the Oyster Cove section of Garden City Beach. The U. S. Army Corps of Engineers routinely dredges the entrance channel of Murrells Inlet and did so in the summer of 2002. Sand from this dredging has been utilized for beach renourishment at Huntington Beach State Park and southern Garden City Beach. Georgetown County has dredged channels south of Captain Dicks Marina near sample stations 04-17A and 04-03A, as well as marina entrance channels north in the vicinity of Station 04-03B.

A flood control structure at a brackish water impoundment adjacent to the Huntington Beach State Park causeway controls salt water intrusion and regulates pond water levels.

- G. Marine Biotoxins** - South Carolina experienced its first documented occurrence of the toxic dinoflagellate, *Ptychodiscus brevis*, during the 1987-1988 shellfish-harvesting season. The Murrells Inlet area was closed to shellfish harvesting on February 1, 1988, as a result of this occurrence. The area was subsequently reopened on March 11, 1988, after laboratory analyses indicated that oysters and clams in the area had purged themselves of the biotoxin. A complete account is available in a SCDHEC report entitled "Red Tide in South Carolina". No marine biotoxins have been identified in the area since that time.

HYDROGRAPHIC AND METEOROLOGICAL CHARACTERISTICS

PHYSIOGRAPHY

The Murrells Inlet and Pawleys Island/Litchfield systems are classical well-mixed, meso-tidal, bar-built estuaries typical of the northern coastal region of South Carolina. In terms of freshwater input, the estuaries conform closely to the definition of a neutral embayment (Odum and Copeland, 1974). Murrells Inlet is approximately 5.5 nautical miles in length with an average width of less than 1 nautical mile. The maximum width is approximately 1.5 nautical miles. Main channel depths are approximately 4 meters. The Pawleys Island/Litchfield system is approximately 5.5 nautical miles in length with typical widths of less than one-half nautical mile. Depths rarely exceed 2.5 meters in this system.

The Murrells Inlet and Pawleys Island/Litchfield systems are similar in terms of estuarine geological development. Characteristic of both systems are ebb and flood tidal deltas, protective point bars (although not readily apparent in Murrells Inlet due to rubble jetty construction), expansive intertidal mud flats, and intertidal oyster reefs. Small meandering creeks as well as high marsh areas dominated by smooth cord grass (*Spartina alterniflora*) are also prevalent.

The most obvious difference between the two estuarine systems is at the inlet mouths. Murrells Inlet has a rubble jetty system, completed in 1980, extending approximately 1,000 meters seaward which serves to stabilize the inlet entrance channel (Van Dolah et al., 1983). Considerable shoaling has occurred around both jetties. In contrast, two separate inlets; Midway Inlet to the north and Pawleys Inlet to the south feed the Pawleys Island/Litchfield system. There is very little intermixing of waters from these two inlets, partially due to the two causeways extending from the mainland onto Pawleys Island. The southern causeway appears to impede flushing action in the south-central portion of the estuary. A tidal node has been observed in the vicinity of this causeway.

Water temperatures in shallow portions of the estuaries often differ from temperatures in adjacent coastal waters. Overnight changes in temperature of five degrees centigrade are not unusual.

Tides - Tides in Area 04 are semidiurnal, consisting of two low and two high tides occurring each lunar day. Mean tidal range in Murrells Inlet varies from 4.2 feet to 4.5 feet, dependent upon location. Spring tides range from 4.7 feet to 5.3 feet. Mean tidal range in the Pawleys Island/Litchfield system varies from 2.9 feet to 4.9 feet, and spring tides range from 3.2 feet to 5.7 feet (Tides and Currents for Windows,

1997). Wind direction and intensity, as well as atmospheric pressure, can alter predicted tidal ranges.

Rainfall - Precipitation in Area 04 is generally heaviest during late summer and early autumn. Tropical storms or hurricanes also produce large amounts of rainfall when they occur. During winter months, rainfall amounts usually decline and events are more uniform in occurrence. However, winter thunderstorms associated with rapidly moving low-pressure systems can generate heavy rains. Precipitation in the form of snow or ice rarely occurs. Spring weather patterns are often dynamic and occasionally produce hail and tornados.

Winds - Prevailing winds along the northern portion of the South Carolina coast are from the south during the spring and summer and from the north during autumn and winter. Wind speeds are typically less than 15 miles per hour (mph); however, strong weather systems can generate winds in excess of 25 mph. Tropical storms and hurricanes are unusual but occasionally occur during summer and autumn. "Northeasters" frequently occur during late autumn and early winter months.

Freshwater Inflow - The lack of major freshwater input into this area results in a generally homogenous salinity distribution. Freshwater input is limited to precipitation and resulting runoff, thus salinities are generally greater than 30 parts per thousand (ppt) through the estuaries. Surface water salinities of less than 20 ppt may be encountered near drainage ditches.

WATER QUALITY STUDIES

DESCRIPTION OF PROGRAM

The Department utilizes a systematic random sampling (SRS) strategy within Area 04 in lieu of sampling under adverse pollution conditions. In order to comply with NSSP guidelines, a minimum of thirty samples are required to be collected and analyzed from each station during the review period. Sampling dates are computer generated prior to the beginning of each quarterly period thereby insuring random selection with respect to tidal stage and weather. Day of week selection criteria is limited to Mondays, Tuesdays, and Wednesdays due to shipping requirements and laboratory manpower constraints. Sample schedules are rarely altered.

During July 1998, an updated data analysis procedure was formalized. Samples utilized for classification purposes are limited to those samples collected in accordance with the SRS for a 36-month period beginning January 1 and ending December 31. This allows for a maximum of 36 samples per station, yet provides a six-sample "cushion" (above the NSSP required 30 minimum) for broken samples, lab error, breakdowns, etc. This also allows each annual report to meet the NSSP Triennial Review sampling criteria.

During the period 01/01/01 through 12/31/03, one thousand-one hundred and eighty eight (1188) surface water samples (<1.0 ft. deep) were collected at the thirty-one currently active Area 04 monitoring stations for bacteriological analyses. Of this total, 1040 samples were utilized for classification purposes in accordance with the Department's systematic random sampling plan. Samples were collected in 120 ml amber glass bottles, immediately placed on ice and transported by bus to the South Carolina Department of Health and Environmental Control's Trident District Environmental Quality Control laboratory at North

Charleston, South Carolina. An additional 120 ml water sample was included with each shipment as a temperature control. Upon receipt at the laboratory, sample sets that exceeded a 30-hour holding time or contained a temperature control >10 degrees C. were discarded. Samples collected after September 1, 1986 have been analyzed using the five-tube/three dilution modified A-1 method described by Nuefeld (1985).

Surface water temperatures were measured utilizing hand-held, laboratory-quality calibrated centigrade thermometers. Salinity measurements were measured in the laboratory using automatic temperature compensated refractometers. Additional field data include ambient air temperature, wind direction, tidal stage and date and time of sampling. Tidal stages were determined using Nautical Software's Tides and Currents, Version 2.2 (1997).

MONITORING RESULTS

Area 04 stations 01, 08, 16, 26 (Murrells Inlet) and 09, 10, 11, 12, 14, 19 and 21 (Pawleys Island/Litchfield) exceed a fecal coliform MPN geometric mean value of 14. Stations 01, 02, 06, 08, 16, 17, 26, 27 and 28 (Murrells Inlet) and 09, 10, 11, 12, 13, 14, 15, 19, and 21 (Pawleys Island/Litchfield) exceed a fecal coliform MPN estimated 90th percentile value of 43. No station exceeds a fecal coliform geometric mean MPN value of 88, however, stations 01, 08, and 16 (Murrells Inlet) and stations 09, 10, 12, 14, and 19 (Pawleys Island/Litchfield) exceed a fecal coliform MPN estimated 90th percentile value of 260. Stations 03A, 03B, 04A, and 17 are newly created stations and lack the minimum number of samples required for classification. A fecal coliform data summary table is included on page 23. An additional summary of selected stations is included on page 24.. A fecal coliform bacteriological raw data collected between 01/01/01 and 12/31/2003 are included beginning on page 26.

CONCLUSIONS AND RECOMMENDATIONS

Based upon review of current bacteriological and shoreline survey data, no classification change is recommended. Management of the Murrells Inlet Conditional Approved area is based upon several factors that influence water quality. Water quality at Station 06 is adversely impacted by water exiting Parsonage Creek during ebb tide. This impact is primarily limited to the creek and does not affect nearby Weston Flat because that area receives inflow via the eastern portion of the estuary. This limits any mixing of saline water in the central portion of the estuary with runoff from inland ditches. Additionally, several stations located within the current Conditionally Approved portions of Murrells Inlet exhibit geometric mean MPN's of less than 14 and Estimated 90th Percentile values of less than 43. Thirdly, this area's Conditionally Approved Area management plan is based upon 1.0 inches of rainfall per twenty-four hours, as recorded at the NOAA National Weather Service Brookgreen Gardens station. Sewage overflows are infrequent and are recommended to continue to be treated as precautionary closures.

South Carolina shellfish related regulation R.61-47 sets no upper limit for Restricted waters. Areas in proximity to Murrells Inlet stations 01, 08, and 16 may, with special permit, be utilized as a source of shellfish for relay, but not depuration purposes. Marinas will retain their administrative Prohibited classification. Additionally, the entire estuary will be placed under a precautionary closure in conjunction with the issuance of an official Hurricane or Tropical Storm Warning or upon receipt of four or more inches of rainfall within twenty-four hours, as recorded at the NOAA National Weather Service Brookgreen

Gardens station.

All but two shellfish monitoring stations within the Pawleys Island/Litchfield estuary exceed both the geometric mean and the estimated 90th percentile shellfish indicator standards criteria for this reporting period. The Pawleys Island/Litchfield portion of Shellfish Area 04 often exhibits acceptable water quality during prolonged dry weather periods. Due to interest expressed by local residents, additional efforts should be directed towards determination of specific rainfall amounts that impact the estuary's water quality. It may be possible to conditionally manage a portion of the estuary based upon the predictable receipt (close), or the lack of (open), rainfall runoff. A determination of the feasibility of the conditional management plan must consider the amount and frequency of rainfall events that degrade water quality, determination of the likely sources of fecal contamination, as well as sampling, enforcement and laboratory manpower constraints. In order to meet National Shellfish Sanitation Program requirements, a management plan based on modest, frequent rainfall events and that targets short-term, dry weather periods for opening would require an intensive special sampling effort that supplements the current systematic random strategy.

Based upon the findings of this Annual Update, the following classification is recommended:

Prohibited:

Murrells Inlet

1. Those waters within approximately 1000 feet of Captain Dick's/Voyager View Marinas;
2. Those waters within approximately 1000 feet of the docking facilities of Bovines, Snug Harbor, H & C Fishers, and Anchor Inn;
3. Those waters within approximately 1000 feet of Marina Colony;
4. Those waters within approximately 1000 feet of the Marlin Quay Marina.

Pawleys Island/Litchfield

None.

Restricted:

Murrells Inlet

1. Portions of the Garden City Canal north of the Marlin Quay Marina closure zone
2. All portions of Main Creek north of Flagg Creek, including the adjacent flats extending eastward from Station 25 to the Garden City Canal;
3. All waters of Parsonage Creek extraneous of marina closure zones,
4. All small feeder creeks and marsh adjacent to the mainland extending from the northern end of Allston Creek to a point 200 meters south of Hughes Landing;
5. Those waters within 1000 feet of the Huntington Beach State Park pond outfall.
6. Alston Creek, from Station 07 to Parsonage Creek.
7. Main Creek, from Station 02 to Station 27.

Pawleys Island/Litchfield

All waters.

Conditionally Approved:

Murrells Inlet

1. All portions of Flagg Creek and adjacent flats not included in the Marina Colony closure zone;
2. The Garden City Canal, between station 04A and the Marlin Quay Marina closure zone;
3. Oaks Creek and adjacent flats, from Station 18 to within 1000 feet of the Huntington Beach State Park pond outfall, including Public Shellfish Ground R351;
4. All portions of the central part of the Murrells Inlet estuary, west of a line extending from the Voyagers View marina closure zone to the extreme eastern portion of Allston Creek, excluding all portions of Parsonage and Allston Creeks.
5. All waters of Oyster Cove.

Pawleys Island/Litchfield

None.

Approved:

Murrells Inlet

1. Those portions of Main Creek extending from Station 25 to Station 05, excluding Marina closure zones;
2. Culture Permit area 356;
3. Portions of Allston Creek, from Station 07 to Oaks Creek.
4. Those portions of Oaks Creek and areas adjacent to Drunken Jack Island from Station 05 to Station 18.
5. Southern portions of the estuary from Station 07 to Station 18, including State Shellfish Ground S354 and portions of Public Shellfish Ground R355;
6. All portions of the central part of the estuary east of a line extending from the Voyagers View marina closure zone near Station 17 to Station 24, excluding any portions of Allston Creek, any portion of Captain Dick's - Voyagers View Marina closure zone, and any portion of Oyster Cove;
7. C370 and portions of C371, excluding marina closure zones and portions of C371 north of Flagg Creek and east of Main Creek.

Pawleys Island/Litchfield

None.

Station Addition/Re/Deactivation/Modification:

Deactivation: 04-04;

Addition: Station 04-04B, Main Creek at the Northern Boundary of Marlin Quay Marina closure zone, 33-33-16, 79-01-18;

Addition: Station 04-04C, Main Creek at the western Boundary of Marlin Quay Marina closure zone, 33-33-07, 79-01-25.

Analysis of sampling data for Area 04 demonstrates the probability of a significant impact from

rainfall exceeding 4.00" in a 24-hour period. Therefore, a precautionary closure of Area 04 will be implemented following rainfall events of greater than 4.00" in a 24-hour period, as measured at Brookgreen Gardens. This methodology is associated with the concept of the Probable Maximum Precipitation (PMP). PMP estimates for the coastal United States have been published in a series of hydro-meteorological reports (HMRs) by the National Weather Service (*National Weather Service*). PMP estimates for South Carolina's growing areas are derived from HMRs 51, 52, and 53 (*National Research Council, 1985*).

REFERENCES

National Research Council, 1985, *Safety of Dams - Flood and Earthquake Criteria* National Academy Press, Washington DC.

National Weather Service. The National Oceanic and Atmospheric Administration. *Precipitation Frequency Atlas of the Western US: NOAA Atlas II*. Superintendent of Documents, US Government Printing Office - Washington DC.

Nuefeld, N. 1985. "Procedures for the Bacteriological Examination of Seawater and Shellfish". In: A.E. Greenberg and D.A. Hunt (eds.) *Laboratory Procedures for the Examination of Seawater and Shellfish, Fifth Edition*. American Public Health Association, Washington, D.C. p. 37-63.

Table #1
Murrells Inlet
Pollution Event Closures
2003

<u>Violation Date</u>	Event	Sample Date	Open Date	Notes
12/10/2003	Rainfall Violation	01/08/2003	01/10/2003	Conditional Areas
03/16/2003	Rainfall Violation	04/21/2003	04/23/2003	Conditional Areas
04/26/2003	Multiple Rainfall Violations	05/19/2003	Unable to open before season closed	Conditional Areas
05/31/2003	Season Closed			Clam Season Ends 5/31
09/06/2003	Rainfall Violation	09/14/2003	09/20/2003	Conditional Area Opening Delayed
09/17/2003	Precautionary Closure	09/14/2003	09/20/2003	Hurricane Warning issued No rainfall
10/08/2003	Multiple Rainfall Violations	11/12/2003	11/14/2003	Conditional Areas

TABLE #2
Shellfish Management Area 04
WATER QUALITY SAMPLING STATIONS DESCRIPTION

<u>Station</u>	<u>Description</u>
01	Main Creek at Atlantic Avenue Bridge
02	Main Creek at Mickey Spillane's Home
03A	In Main Creek, Southeast side of the Prohibited Area near Captain Dick's Marina
03B	In Main Creek, on the Northwest Side of the Prohibited Area near Captain Dick's Marina
04	Main Creek at Marlin Quay Marina
04A	Garden City Canal due east of Flagg Creek (New 01-01-2004)
05	Murrells Inlet - Range Marker
06	Allston Creek at Weston Flat
07	Allston Creek - Hughes Landing
08	Parsonage Creek at Nance's Dock
08A	Oyster (Carr) Landing at Huntington Beach Station Park
09	Clubhouse Creek at Litchfield Boulevard Bridge
10	Shell Avenue and Pawley's Island Creek
11	North Causeway Bridge at Pawley's Island Creek
12	South Causeway Bridge at Pawley's Island Creek
13	Pawley's Inlet
14	Dock - End of Sportsman Boulevard
15	Midway Inlet
16	Parsonage Creek at Chicken Farm Ditch
17A	Southwest Corner of the Voyager View Marina Prohibited Zone in Parsonage Creek
18	North Boundary of Clambank Flats POG
19	Clubhouse Creek - First Bend South of Salt Marsh Cove
21	South Pawley's Island Boat Landing
23	Main Creek at Oyster Cove
24	Oaks Creek at First Curve
25	Main Creek at Flagg Creek
26	Garden City Canal at the "Old Boat Wreck"
27	Main Creek, Opposite Entrance to Mt. Gilead Canal
28	Oak's Creek, Approx. 150 Meters from the Huntington Beach State Park Causeway
29	Oyster Cove, South Branch
30	Oyster Cove, North Branch
31	Woodland Creek - 100 Meters East of Mainland
(Total 32)	

Figure 1.
Shellfish Management Area 04
Prior Classification

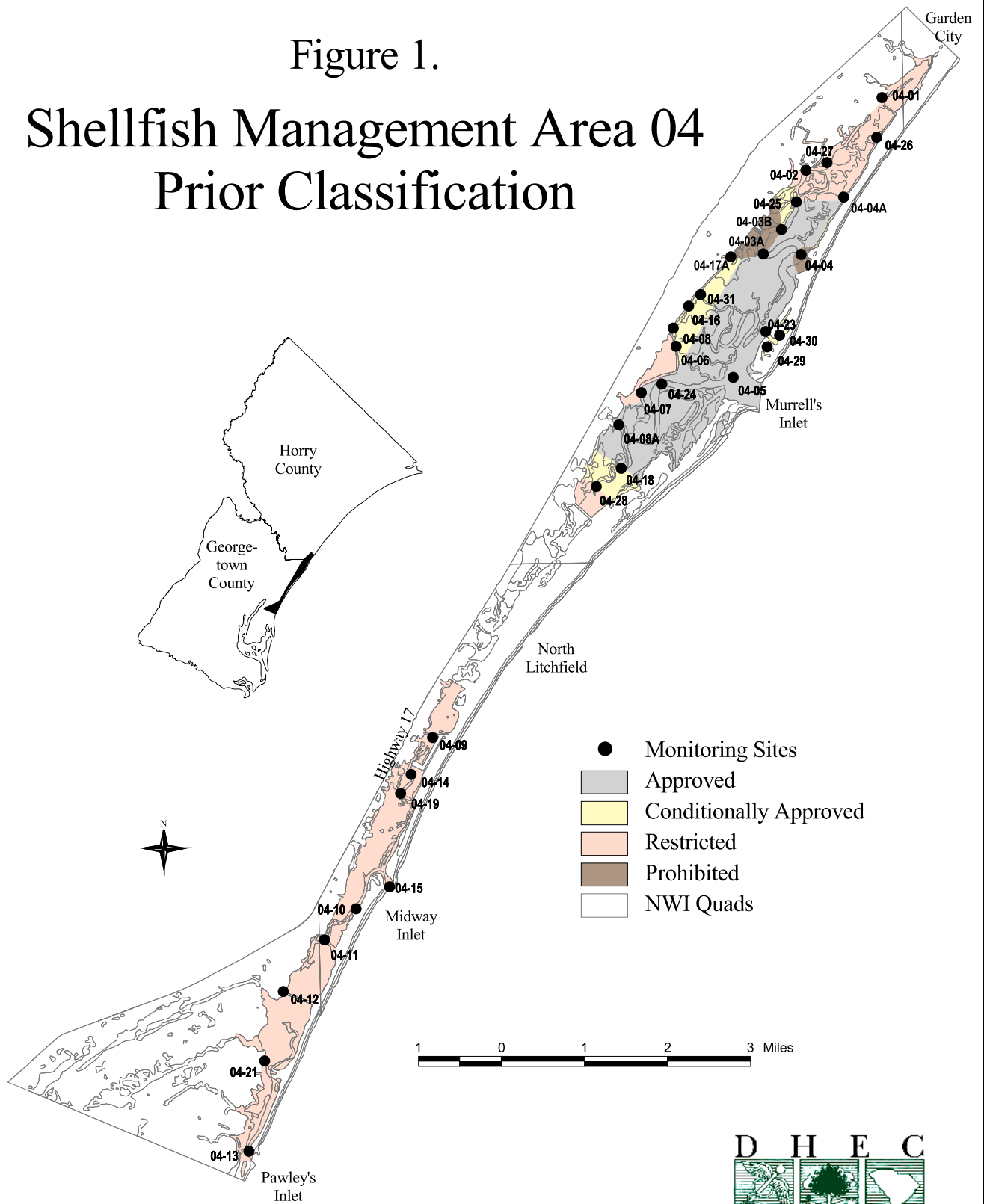


Figure 2.
Shellfish Management Area 04
Current Classification

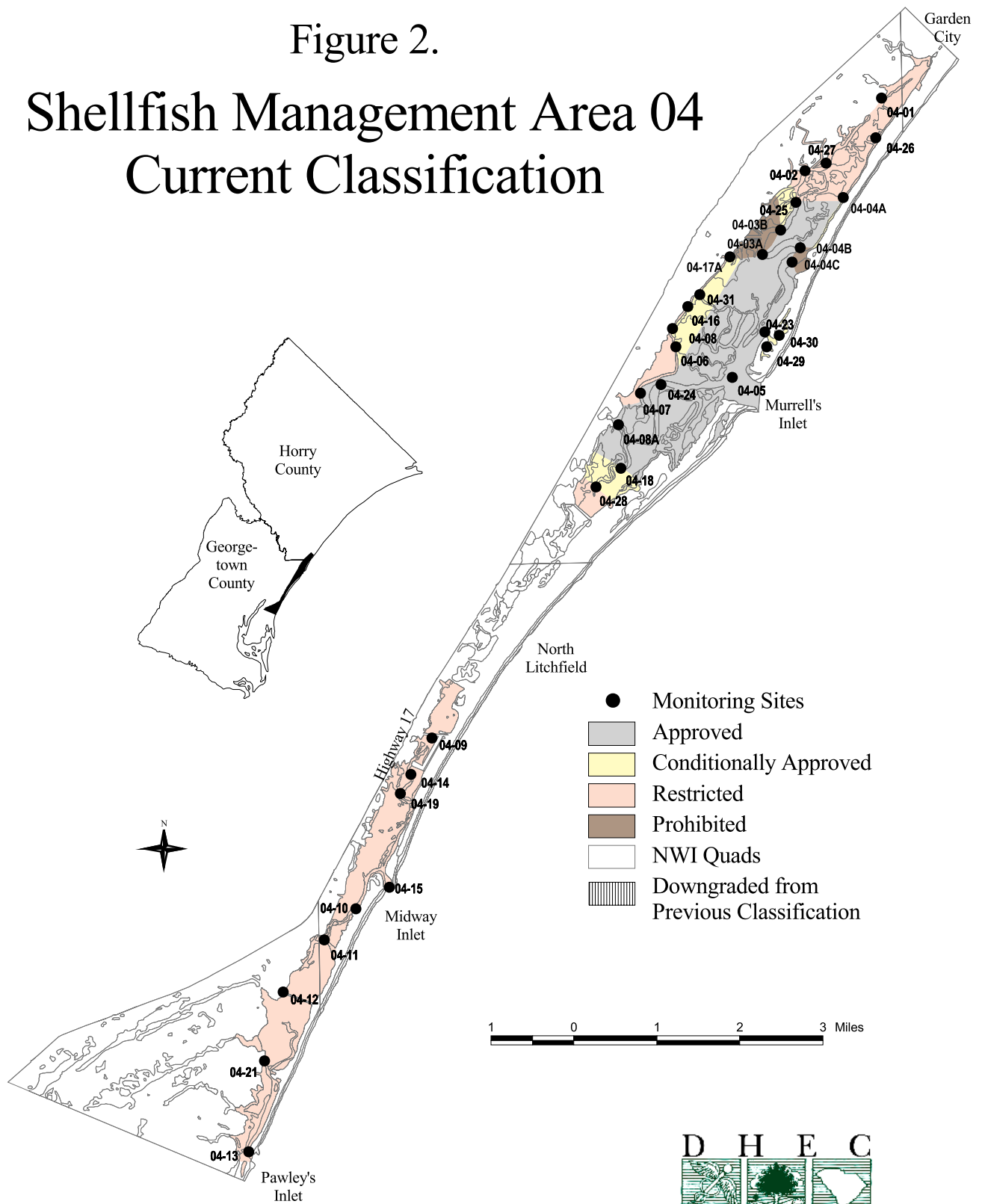


Figure 3. Shellfish Management Area 04 Potential Pollution Sources

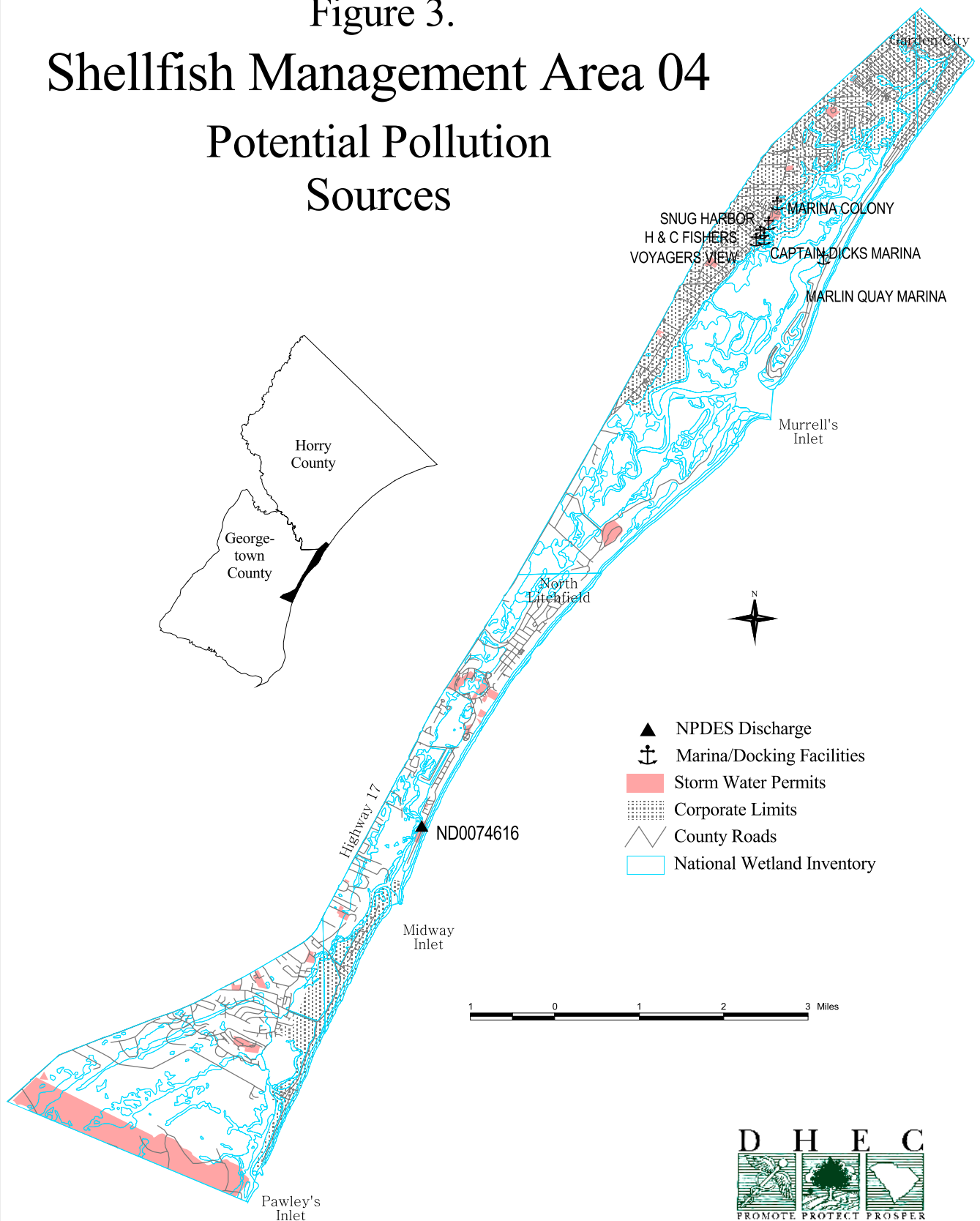


TABLE #3 (A)
Shellfish Management Area 04

FECAL COLIFORM BACTERIOLOGICAL DATA SUMMARY
From Shellfish Water Quality Sampling Stations Between

January 01, 2001 and December 31, 2003

Station No.	01	02	03A	03B	04	04A	05	06	07	08	08A
Samples	36	36	11	11	36	0	36	36	36	36	36
GeoMean	46.4	8.4	6.9	8.8	5.9	New	2.6	7.6	6.1	28.9	3.8
Est. 90th %ile	546	46	70	65	43	New	5	59	29	371	15
Water Quality	RND	R	New	New	A	New	A	R	A	RND	A
Classification	R	R	New	New	A	New	A	R	A	R	A

Station No.	09	10	11	12	13	14	15	16	17A	18	19
Samples	36	36	36	36	36	36	36	35	11	36	36
GeoMean	55.9	21.4	15.7	27.3	9.5	39.7	9.2	40.4	7.2	6.0	35.0
Est. 90th %ile	554	288	195	292	97	365	85	700	49	29	337
Water Quality	RND	R	R	RND	R	RND	A	RND	New	A	RND
Classification	R	R	R	R	R	R	R	R	New	CA	R

Station No.	21	23	24	25	26	27	28	29	30	31	
Samples	36	36	36	36	36	36	36	36	36	36	
GeoMean	17.8	3.4	3.7	6.6	15.8	11.5	8.7	5.1	4.9	6.7	
Est. 90th %ile	217	13	13	41	155	82	48	34	30	29	
Water Quality	R	A	A	A	R	R	R	A	A	A	
Classification	R	A	A	CA	R	R	R	CA	CA	R	

A - Approved CA - Conditionally Approved R - Restricted
RND - Restricted/No Depuration P - Prohibited

TABLE #3 (B)**SUPPLEMENTAL FECAL COLIFORM BACTERIOLOGICAL DATA SUMMARY #1**

**Routine Samples Collected From Selected Stations
During the Open Status
For the Period January 01, 2001 - December 31, 2003**

Station	2	4	6	18	25
Samples	15	15	15	15	15
GeoMean	6.6	3.4	5.3	4.7	5.9
Est. 90th %ile	22	8	27	17	30
Water Quality	A	A	A	A	A
Classification	R	A	R	CA	CA

Station	26	28	29	30	31
Samples	15	15	15	15	15
GeoMean	7.6	6.3	2.9	2.4	4.6
Est. 90th %ile	35	23	7	4	13
Water Quality	A	A	A	A	A
Classification	R	R	CA	CA	R

A - Approved **CA** - Conditionally Approved **R** - Restricted
RND - Restricted/No Depuration **P** - Prohibited * Action Indicated

Table #4

Water Quality Sampling Stations Data

Shellfish Management Area 04

BACTERIOLOGICAL DATA

Data for each shellfish station listed in this report's "Fecal Coliform Bacteriological Data Summary Table" and in other shellfish reports, can be obtained through South Carolina's Department of Health and Environmental Control - Freedom of Information office at the address below.

Freedom of Information
2600 Bull Street
Columbia, SC 29201

Any explanation or clarity needed on the report's content can be obtained by contacting the preparer(s), and/or reviewer(s) listed on the cover page.

Table #5

Rainfall Data Brookgreen Garden, SC

Shellfish Management Area 04

(Sample days are noted in Bold)

ANNUAL TABLE OF DAILY RAINFALL DATA

SOURCE: Brookgreen Garden, South Carolina

2001	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1st	0.00	0.00	0.00	0.10	0.00	0.00	0.00	0.00	0.10	0.00	0.00	0.00
2nd	0.00	0.00	0.00	0.00	0.00	0.20	0.00	0.00	0.00	0.00	0.00	0.00
3rd	0.00	0.00	0.50	0.00	0.00	0.00	1.70	0.00	1.80	0.00	0.00	0.00
4th	0.00	0.50	0.90	0.00	0.00	0.60	0.20	0.00	0.30	0.00	0.00	0.00
5th	0.00	0.00	0.00	0.00	0.00	0.10	0.10	0.00	0.00	0.00	0.00	0.00
6th	0.00	0.00	0.00	0.00	0.00	0.50	0.00	0.60	0.00	0.00	0.00	0.00
7th	0.00	0.00	0.00	0.00	0.00	0.20	0.00	0.00	0.00	0.60	0.00	0.00
8th	0.30	0.00	0.00	0.00	0.00	0.10	0.40	0.00	0.00	0.00	0.00	0.00
9th	0.00	0.00	0.00	0.00	0.00	0.00	0.20	0.00	0.00	0.00	0.00	0.00
10th	0.00	0.20	0.00	0.00	0.20	0.00	0.00	0.00	0.10	0.00	0.00	0.80
11th	0.00	0.00	0.00	0.00	0.00	0.00	0.20	0.00	1.40	0.00	0.00	2.00
12th	0.50	1.20	0.10	0.00	0.00	0.00	0.00	0.70	0.00	0.00	0.00	0.00
13th	0.00	0.10	2.30	0.00	0.10	0.10	1.80	0.40	0.00	0.00	0.00	0.00
14th	0.10	0.00	0.00	0.00	0.00	0.20	0.00	2.20	0.00	0.00	0.00	0.00
15th	0.00	0.00	1.30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.00
16th	0.00	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
17th	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
18th	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.30	0.00	0.00	0.00	0.10
19th	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
20th	0.00	0.00	3.20	0.00	0.00	0.00	0.90	0.10	0.00	0.00	0.00	0.00
21st	0.00	0.00	0.00	0.00	0.30	0.00	0.00	0.30	0.20	0.00	0.00	0.00
22nd	0.00	0.60	0.00	0.00	0.00	0.60	0.00	0.00	0.00	0.00	0.00	0.00
23rd	0.00	0.00	0.00	0.00	0.00	0.10	1.00	0.00	0.00	0.00	0.00	0.00
24th	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.20	0.60	0.00	0.80	0.00
25th	0.00	0.00	0.20	0.60	0.00	0.30	0.00	0.00	0.10	0.00	0.00	0.00
26th	0.00	0.00	0.00	0.00	0.00	0.10	0.20	0.00	0.00	0.00	0.00	0.00
27th	0.00	0.00	0.00	0.00	0.00	0.00	0.60	0.00	0.00	0.00	0.00	0.00
28th	0.00	0.20	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
29th	0.00		0.00	0.00	0.80	0.00	0.30	1.10	0.00	0.00	0.11	0.00
30th	0.00		0.00	0.00	0.00	0.00	0.00	0.70	0.00	0.00	0.00	0.00
31st	0.00		0.00		0.00		0.00	0.00		0.00		0.00

(Monthly Figures)

Year's Rainfall Total: 41.41

SUM	1.00	2.90	9.00	0.70	1.40	3.10	7.60	6.60	4.60	0.60	1.01	2.90
MAX	0.50	1.20	3.20	0.60	0.80	0.60	1.80	2.20	1.80	0.60	0.80	2.00
MIN	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AVG	0.03	0.10	0.29	0.02	0.05	0.10	0.25	0.21	0.15	0.02	0.03	0.09

"ND" or "--" = missing data / Shaded Cells = the date samples were taken

(Shellfish Management Area 04)

ANNUAL TABLE OF DAILY RAINFALL DATA

SOURCE: Brookgreen Garden, South Carolina

2002	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1st	0.00	0.00	0.00	0.32	0.06		0.00	0.00	0.75	0.00	0.00	0.00
2nd	0.19	0.00	1.32	0.00	0.00		0.00	0.00	0.18	0.00	0.00	0.00
3rd	0.41	0.00	1.11	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
4th	0.00	0.00	0.00	0.00	0.00		0.00	1.73	0.00	0.00	0.09	0.02
5th	0.00	0.00	0.00	0.00	0.88		0.00	0.34	0.00	0.00	0.00	0.09
6th	0.63	0.18	0.00	0.00	0.00		0.62	0.00	0.42	0.00	1.14	0.00
7th	0.00	1.79	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
8th	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	1.24	0.00	0.00
9th	0.00	0.00	0.05	0.00	0.00		0.31	0.00	0.00	0.00	0.00	0.00
10th	0.00	0.41	0.00	0.83	0.00		0.00	0.00	0.00	0.00	0.24	1.47
11th	0.00	0.00	0.00	0.00	0.12		0.00	0.00	0.00	1.68	0.89	0.09
12th	0.00	0.00	0.00	0.00	0.00		3.31	0.00	0.00	0.00	0.00	0.00
13th	0.43	0.00	0.24	0.00	0.00		0.04	0.00	0.00	0.00	0.62	1.69
14th	0.15	0.00	0.00	0.00	0.61		1.13	0.45	0.18	0.24	0.00	0.00
15th	0.41	0.00	0.00	0.00	0.00		0.31	0.00	0.24	1.19	0.06	0.00
16th	0.00	0.00	0.00	0.00	0.00		0.00	0.00	1.18	0.00	0.58	0.00
17th	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.21	0.00
18th	0.00	0.00	0.00	0.00	0.53		0.00	0.21	0.00	0.00	0.00	0.00
19th	0.00	0.00	0.00	0.00	0.37		0.00	0.00	0.00	0.00	0.00	0.26
20th	0.02	0.00	0.00	0.41	0.00		0.00	0.00	0.00	0.00	0.00	0.29
21st	0.09	0.08	0.19	0.00	0.00		0.83	0.00	0.00	0.06	0.00	0.00
22nd	0.00	0.00	0.00	0.00	0.00		1.10	0.00	0.00	0.19	0.00	0.00
23rd	0.00	0.02	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
24th	0.05	0.00	0.00	0.12	0.00		0.41	0.00	0.00	0.41	0.00	0.96
25th	0.11	0.00	0.00	0.00	0.00		0.00	0.33	0.00	0.00	0.00	0.00
26th	0.00	0.00	0.00	0.00	0.00		0.00	0.79	3.23	0.00	0.00	0.00
27th	0.00	0.00	0.12	0.02	0.00		0.53	1.08	0.06	0.00	0.00	0.00
28th	0.00	0.00	0.00	0.00	0.00		0.00	2.12	0.00	0.00	0.00	0.00
29th	0.00		0.00	0.00	0.00		0.00	2.17	0.00	0.21	0.00	0.00
30th	0.00		0.00	0.00	0.05		0.00	0.32	0.00	0.00	0.00	0.00
31st	0.00		0.00		0.00		0.00	0.36		0.00		0.00

(Monthly Figures)

Year's Rainfall Total: 50.97

SUM	2.49	2.48	3.03	1.70	2.62	0.00	8.59	9.90	6.24	5.22	3.83	4.87
MAX	0.63	1.79	1.32	0.83	0.88	0.00	3.31	2.17	3.23	1.68	1.14	1.69
MIN	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AVG	0.08	0.09	0.10	0.06	0.08	0.00	0.28	0.32	0.21	0.17	0.13	0.16

"ND" or "--" = missing data / Shaded Cells = the date samples were taken

(Shellfish Management Area 04)

ANNUAL TABLE OF DAILY RAINFALL DATA

SOURCE: Brookgreen Garden, South Carolina

2003	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1st	0.37	0.00	0.84	0.00	0.00	0.31	0.00	0.00	0.00		0.00	0.00
2nd	0.00	0.00	0.36	0.00	0.00	0.00	1.08	0.00	0.00		0.00	0.00
3rd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.00		0.00	0.00
4th	0.00	0.04	0.00	0.00	0.00	1.10	0.00	0.16	0.00		0.00	0.73
5th	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00
6th	0.00	0.26	0.39	0.16	0.00	0.00	0.11	0.22	1.32		0.04	0.00
7th	0.00	0.62	0.84	1.40	1.36	0.41	0.00	0.03	0.16		0.00	0.00
8th	0.00	0.00	0.00	0.08	0.00	0.50	0.00	0.00	0.00		0.00	0.00
9th	0.00	0.00	0.00	2.26	0.00	0.00	0.00	0.00	0.32		0.00	0.00
10th	0.00	0.41	0.00	0.18	0.00	0.00	0.00	0.02	0.00		0.00	0.72
11th	0.00	0.00	0.00	0.63	0.00	0.00	0.00	0.66	0.00		0.00	0.00
12th	0.00	0.00	0.00	0.00	0.00	0.39	0.89	0.00	0.00		0.00	0.00
13th	0.00	0.00	0.19	0.00	0.00	0.21	0.00	0.00	0.00		0.00	0.00
14th	0.00	0.00	0.00	0.00	0.00	0.05	0.21	0.00	0.00		0.00	0.83
15th	0.00	0.00	1.12	0.00	0.36	0.00	0.00	0.00	0.00		0.00	0.00
16th	0.00	0.58	0.39	0.00	0.35	0.30	0.00	0.00	0.00		0.00	0.00
17th	0.16	0.32	0.21	0.00	0.10	0.00	0.11	0.00	0.00		0.00	0.18
18th	0.00	0.00	0.29	0.00	0.03	1.98	0.00	0.62	0.16		0.00	0.00
19th	0.00	0.00	0.00	0.00	0.00	0.00	1.24	0.21	0.00		0.32	0.00
20th	0.00	0.00	3.24	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00
21st	0.00	0.00	0.71	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00
22nd	0.22	0.38	0.00	0.00	0.04	0.00	0.00	0.06	0.11		0.00	0.00
23rd	0.00	0.06	0.00	0.00	1.72	0.00	0.64	0.00	0.65		0.00	0.04
24th	0.00	0.00	0.00	0.00	0.00	0.00	2.10	0.00	0.00		0.00	0.00
25th	0.00	0.00	0.00	2.16	0.00	0.00	0.05	0.00	0.00		0.00	0.00
26th	0.00	0.00	0.00	0.63	0.00	0.00	0.06	0.00	0.00		0.00	0.00
27th	0.00	0.95	0.00	0.00	0.31	0.00	0.00	0.00	0.06		0.00	0.00
28th	0.00	0.00	0.28	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00
29th	0.00		0.31	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00
30th	0.06		0.52	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00
31st	0.00		0.00		0.00		0.00	0.00				0.00

(Monthly Figures)

Year's Rainfall Total: 45.28

SUM	0.81	3.62	9.69	7.50	4.27	5.25	6.49	2.01	2.78	0.00	0.36	2.50
MAX	0.37	0.95	3.24	2.26	1.72	1.98	2.10	0.66	1.32	0.00	0.32	0.83
MIN	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AVG	0.03	0.13	0.31	0.25	0.14	0.00	0.21	0.06	0.09	0.00	0.01	0.08

"ND" or "--" = missing data / Shaded Cells = the date samples were taken

(Shellfish Management Area 04)

Murrells Inlet Conditionally Approved Areas

Shellfish Management Area 04

MURRELLS INLET

CONDITIONAL AREA MANAGEMENT PLAN

July 2004

I. AREA DESCRIPTION

The following is a description of Murrells Inlet Conditionally Approved areas as indicated in the 2003 Annual Update:

Conditionally Approved:

Murrells Inlet

1. All portions of Flagg Creek and adjacent flats not included in the Marina Colony closure zone;
2. The Garden City Canal, between Station 04A and the Marlin Quay Marina closure zone;
3. Oaks Creek and adjacent flats, from Station 18 to within 1000 feet of the Huntington Beach State Park pond outfall, including Public Shellfish Ground R351;
4. All portions of the central part of the Murrells Inlet estuary, west of a line extending from the Voyagers View marina closure zone to the extreme eastern portion of Allston Creek, excluding all portions of Parsonage and Allston Creeks.
5. All waters of Oyster Cove.

Pawleys Island/Litchfield

None

No changes in Conditionally Approved area boundary changes will be implemented for 2004. A map indicating the boundaries of the Murrells Inlet Conditionally Approved area is included in the 2004 Annual Report

II. Factors Indicating Suitability of Murrells Inlet as a Conditionally Approved Area

- A. The major pollution source adversely affecting water quality in Murrells Inlet is nonpoint source in origin.
- B. Murrells Inlet receives no substantial freshwater input other than from rainfall and associated runoff.
- C. Murrells Inlet has a tidal range sufficient to allow substantial exchange with coastal ocean waters. This exchange results in a typical salinity range of 30 ppt to 35 ppt. Depressed salinities due to rainfall are temporary.
- D. Murrells Inlet is relatively small geographically and does not present major patrol difficulties.

III. PREDICTABLE POLLUTION EVENTS

A. Meteorological Events

1. Sanitary Surveys indicate that a 24-hour rainfall total of 1.0 inches results in degradation of water quality through portions of the estuary, while lesser amounts occurring in 24 hours do not appear to result in adverse affects.

B. Seasonal Events

1. No marinas will be conditionally managed.
2. Rainfall quantities are fairly uniform throughout fall, winter, and spring. Rainfall varies in intensity and duration; however, it is more uniform in nature during the winter months. Fall and spring rainfall patterns are typically more dynamic, with thunderstorms being quite common.
2. Murrells Inlet Conditionally Approved areas should remain in a closed status during the summer months.
3. Potential impacts from migratory waterfowl populations are mitigated by tidal flushing.

IV. IMPLEMENTATION OF A CONDITIONAL AREA CLOSURE

A. Notification of management plan violation

1. Closures will be implement upon receipt of 1.0 inches of rain as recorded at NOAA's Brookgreen Gardens station.
2. DHEC is responsible for determining compliance with this management plan.
3. Rainfall measurements are checked daily (am) at several locations along South Carolina's northern coast. If these gauges indicate 0.5 inches or more, a DHEC officer will contact the Brookgreen Gardens station for specific information.
3. Determination of violation will normally transpire within 16 hours.
4. Conditionally Approved portions of Murrells Inlet will remain in a closed status from June 1 through August 31.

B. Implementation of Closure (September through May)

1. If determination of a violation occurs during normal working hours, a press release will normally be issued within four hours. If determination of a violation occurs after normal working hours, a press release will be issued the following day.
2. SCDHEC will notify Shellstock Shippers operating Culture Permit Areas (private leases) or buying from State Shellfish Ground permit holders within Murrells Inlet by telephone. Notification will be provided by fax, telephone, or email to the South Carolina Department of Natural Resources (MRD and local law enforcement). Major boat landings will be posted.

3. SCDHEC is the agency responsible for patrol of shellfish areas closed for public health protection.

C. Enforcement of Closure

1. SCDHEC is the agency responsible for public health protection. This includes public notice and closures of shellfish harvest areas.
2. Murrells Inlet will be patrolled at frequencies to deter illegal harvest during closures of Conditionally Approved areas. SCDHEC Shellfish Sanitation Program officers may coordinate with other law enforcement agencies to insure adequate area coverage.

V. CRITERIA FOR REOPENING AFTER A POLLUTION EVENT

Control Elements

1. Cessation of causative rain event as officially measured at the NOAA Brookgreen Gardens.
2. For the 2004-2005 shellfish season, the following stations shall be sampled prior to reopening: 02, 03B, 04 (ending 12/04), 04A, 04B and 04C (beginning 01/05), 06, 17A, 18, 25, 28, 29, 30 and 31.
3. Data indicate that Conditionally Approved portions of Murrells Inlet typically exhibit acceptable water quality within 48 hours following moderate rain events. Murrells Inlet Conditionally Approved areas shall exhibit acceptable water quality prior to reopening.
4. For purposes of this management plan, acceptable water quality shall mean that not more than 15% of monitoring station samples collected within, or on the boundary of, Conditionally Approved areas shall exceed a most probable number value of 43 FC/100 ml.
5. Low water temperatures have been shown to lower metabolic rates of shellfish. It is likely that these same temperatures inhibit shellfish from bioaccumulation of bacteriological contaminants. Except during periods of atypical temperatures, metabolic activity should be sufficient to allow natural cleansing.
6. Fourteen consecutive days absent violation of rainfall criteria has been shown to be acceptable for cleansing. Closures will remain in effect for a minimum of 14 consecutive days.

VI. MANAGEMENT PLAN Evaluation

This plan shall be evaluated once per year and included as a part of the Shellfish Management Area 04 Annual Update.

Shellfish Management Area 04
EVALUATION OF MANAGEMENT PLAN

EVALUATION

The current management plan evaluation period is January 1, 2003 through December 31, 2003. Bacteriological water quality samples used for classification purposes were collected monthly from each station within Area 04. Additionally, sampling was conducted in order to confirm water quality conditions for Conditional Area openings. Unless pre-scheduled sampling (systematic random sampling) followed the pollution events and thus could also be used for opening determination, a set of special samples were collected from stations within and bordering the conditional areas.

1. Compliance - Conditionally Approved areas were closed well within specified time-lines.
2. All occurrences of rainfall greater than or equal to 1.0 inches were followed by a Conditional Area closure.
3. Notifications of rainfall criteria violations were always prompt.
4. No precautionary closures were issued during 2001. One precautionary closure was implemented during 2002 due to Tropical Storm Kyle. One precautionary closure was issued during 2003 due to Hurricane Isabel.
5. Water quality data indicate compliance with Approved Growing Area criteria. Table 3(B) indicates Conditionally Approved area sample quality over the three-year review period.
6. The primary pollution source in Area 04 is non-point source pollution that enters the estuary via several ponds and drainage ditches. These have been well documented over the last 20 years. Sewage lift station blockages have sporadically induced overflows, which have resulted in emergency closures. These lift stations include audible and visual alarms as well as telemetry and routinely checked by the SCDHEC local district office for compliance.
7. Conditionally Approved and boundary sample stations were sampled on 50 different dates (49 times at Station 25) during the three-year review period. Thirty-six routine systematic random samples and 14 special reopening samples (typically three to four days prior to reopening) were collected from the stations (13 from Station 25). For the three-year review period, stations were sampled 15 times while in the open status.
8. No marinas were conditionally managed. Marinas are circumscribed by a minimum 1000' Prohibited closure zone.

RECOMMENDATIONS

Overall Conditionally Approved area management, based upon the present management plan, has been successful. The area will continue to be managed based upon receipt of 1.0 inches of rainfall in 24-

hours, as officially measured at NOAA's Brookgreen Gardens station. The specific listing of stations requiring sampling prior to reopening has been amended.